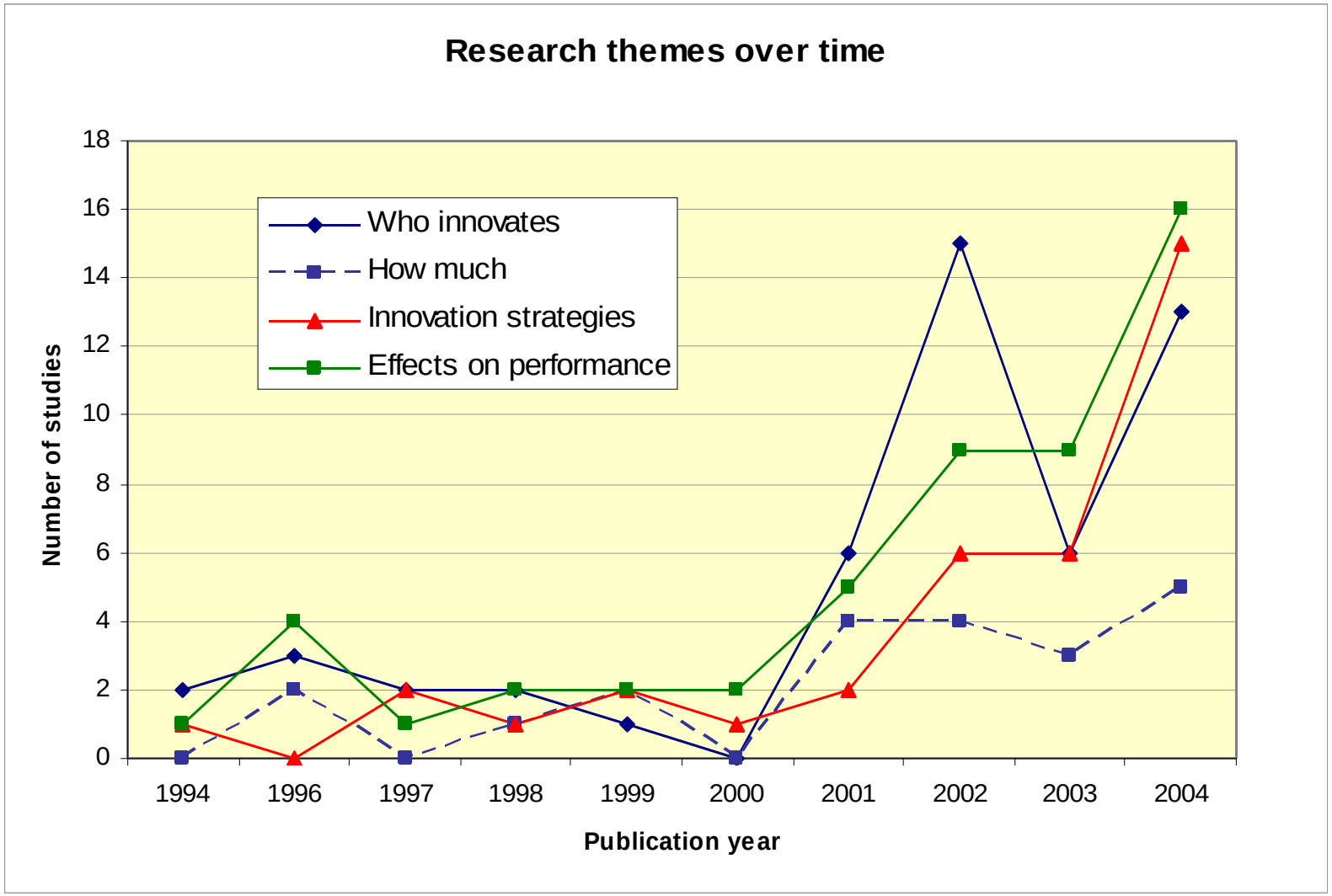
Interpreting Innovation Surveys 2

1. A note on interaction effects

- Serious issue that affects use of sector, size, or other dummy variables.
- Assumption is that sector effects are parallel – no difference in effect of sector on dependent variable across other variables such as firm size.
- Often not the case – need to introduce interaction variables *and/or* calculate separate regressions by major criteria of interest: ie separate regressions for small and large firms.
  - *Note: Very few econometric studies using innovation survey data include* ***2. Econometric research*** *interaction effects*

2.1 Main Econometric research topics

1. Who innovates?
   - ….at what level (novelty, in-house…)
1. If a firm innovates, what are its innovation strategies?
2. What effect do these strategies have on performance outcomes?


Research themes over time
Number of studies
18
16
14
12
10
8
6
4
2
0
Who innovates
How much
Innovation strategies
Effects on performance
1994
1996
1997
1998
1999
2000
2001
2002
2003
2004
Publication year

2.2 Who innovates

Determinants of innovative status

- What differentiates innovative from non-innovative firms?
- or firms that introduce different ***types*** of innovations?
  - Products
  - Processes
  - Organisational methods

2.3 Innovation strategies

- Innovation objectives and obstacles.
  - Little work on this topic, even though obstacles should be of great interest to policy
- Effect of public funding on innovation intensity – additive or substitutes?
- External sourcing of knowledge.
  - Collaboration and innovation
- Appropriation and intellectual property rights.

2.4 Innovation and performance

Three common measures:

- Change in employment
- innovation sales share for products (best)
- productivity (sales per employee – no value added data; requires linking to other data files)

- Plus, patenting status sometimes used (Don’t do it for all sectors – OK within sectors)

2.5 CDM model (Crepon-Duguet-Mairesse)

- 3-stage model for solving cross-sectional nature of CIS data in analyses of performance
  - Probit selection model to identify determinants of innovative status (did they innovate, yes or no, but usually **R&D**)
  - Research equation (Tobit) for the intensity of innovation (almost always **R&D**)
  - Innovation output equation: dependent variable can be innovative sales share, patents, etc

2.6 Some performance results

- Knowledge management policies improve patent rates (Kremp & Mairesse, 2004)
- Innovation intensity determined by share of highly-skilled employees (Janz & Peters, 2002)
- Labour productivity ***increases*** with innovation intensity (Janz et al, 2003; Loof, 2004)
- Labour productivity in the service sector ***decreases*** with innovation intensity **(**Ferreira and Mira, 2005) **.**

2.7 Appropriation example

Does the use of formal appropriation methods such as patents improve the probability of collaborating?

Illustrates the problems of using an innovation survey to address a policy issue.

2.8 Appropriation options

- Use strong **formal** protection methods (patents, copyright, design registration)
- Use '**strategic**' or non-formal protection methods such as secrecy, first mover advantages, and technical complexity.

Relationship between appropriation methods & collaboration

	Positive correlation with collaboration	No effect or negative correlation
Formal methods (patents, etc)	Dachs, 2004 (Finland) Loof & Brostrom, 2004 (Sweden) Arundel, 2001 (7 countries) Brouwer & Kleinknecht, 1999 (Netherlands) Czarnitzki et al, 2004 (Finland and Germany) Czarnitzki & Fier, 2003 (Germany)	Schmidt, 2004 (Germany) Dachs, 2004 (Austria) Bonte & Keilbach, 2004(Germany)
Strategic methods (secrecy, etc)	Cassiman & Veugelers, 2001 (Belgium) Dachs, 2004 (Finland) Bonte & Keilbach, 2004 (Germany)	Veugelers & Cassiman, 2004 (Belgium) Dachs, 2004 (Austria)

2.9 Formal or strategic?

- Not clear that strong formal protection methods are promoters of collaboration, since most studies did not look at both methods.
- Exception: study by Bonte and Keilbach:
  - A multinomial model with three different cooperation categories with suppliers or customers as the dependent variable.
    - Informal cooperation
    - Formal cooperation
    - No cooperation

Bonte and Keilbach (cont)

- Includes both strategic and formal protection methods in each model:
  - Strategic protection methods (aggregation of ordinal scores for secrecy, lead time, complexity)
  - Industry level measure of scores for formal protection method (patents, copyright, brand names)
- Compared to ‘no cooperation’, formal protection methods has no effect on either formal or informal collaboration.
- Compared to no cooperation, strategic protection methods have a strong positive effect on collaboration.

Bonte and Keilbach (cont)

- Comments:
  - Results only applicable to vertical supply chains (suppliers and customers). These could differ from cooperation with competitors, universities, etc.
  - Not clear why variable for formal protection methods (patents) is entered as an industry dummy.
  - No data on if value of formal or informal protection methods are directly linked to cooperation – only firm averages.

Veugelers & Cassiman, 2005

- Focus on collaborations between firms and universities
- Same construction of formal and strategic variables as with Bonte & Keilbach (strategic at firm level, formal at industry level)
- Strategic protection methods have no effect, whereas formal protection methods have a strong positive effect

Veugelers & Cassiman, 2005

- Comments:
  - Gives opposite result, but for collaboration with universities – is this the reason?
  - Using industry level variables for formal protection methods creates a confounding problem:
    - Sectors with high importance given to patent protection have a high probability of collaborating with universities: pharmaceuticals and ICT
    - Do not know if formal protection actually used with universities
    - Is the driver of collaboration related to formal protection, or is formal protection really relevant?

2.10 Why do we find conflicting results?

- **Country effects** (National innovation systems)?
- **Over-interpretation of the data**
  - No direct link between the value of appropriation to the firm (a market variable) and the use of patents and strategic methods as enablers of collaboration
- **Different model formulations**? – problem with using cross-sectional data to explore causation.

3. Lessons for survey-based research

3.1 Main problem

- Conflicting results from study to study on some issues of major interest (appropriation, performance, etc).
- Creates ‘unease’ among policy makers – what to believe?

3.2 Limitations of surveys

There is a “long standing tension between [innovation surveys], with their advantage of generality but lack of depth, versus case study methods, which offer richness at the expense of generalizability”.

– Keith Smith (2004)

- *Need in-depth research to explain the ‘why’ of innovation survey results*

3.3 Hazard of over interpreting data

- Trying to fit a square peg into a round hole is a common problem with innovation survey research – theory driven analysis can conflict with the actual question.
- If you use published papers on survey data in your research, find the original survey questionnaire and check how the author's have interpreted the questions.
  - Also look for data on the reliability of the survey.

3.4 Carefully sift through data

- Both positive and negative results can be limited to specific sectors or conditions.
  - Break up analyses to identify the drivers of specific results – are they consistent across sectors or firm size classes?
    - Note: Controlling for sectors or size classes in a model assumes no interaction effects, which may not be true.
- What methods did the authors use to evaluate their data?

4. Future research areas

4.1 Heavily explored topics:

- Knowledge sourcing
- Collaboration
  - *Exception –with competitors*
- Effect of R&D status on performance
- Appropriation (patents, etc)
- Role of ‘public science’
- *If you look at these topics, you need something new!*

4.2 ‘Unexplored’ topics

- What factors hinder *innovative* firms in their ability to innovate?
- Effects of innovation on “non economic” outcomes:
  - **Environmental**
  - Market strategies
  - Process flexibility
- Interaction between different types of innovative activities (product, process, organisational) on firm performance
- Process innovation and performance
- Innovation among non-R&D performing innovators
- Role of markets – domestic, international etc.

A note on environmental innovation

2c. During 2005 to 2007, did your enterprise introduce any environmentally beneficial innovations specifically in response to the following:

	Yes	No
1. Legal prohibitions or technology/performance standards	☐	☐
2. Environmental taxes, subsidies, other financial incentives	☐	☐
3. Tradable permits or quotas	☐	☐
4. Information measures such as eco-labels	☐	☐
5. Voluntary codes of practice or negotiated agreements/covenants	☐	☐

Are firms reacting to policy signals?

A few slides on neglected innovators

- Main results of study for non-R&D innovators:
  - Their activities are similar to R&D performers: 71% develop innovations in-house compared to 91% of R&D performers.
  - They are less likely to benefit from innovation support programmes including programmes that ***do not*** require R&D.
  - There is no revenue penalty for not performing R&D.

R&D status by change in turnover 2004 to 2006

Change in income	No R&D	R&D in-house
Decreased > 25%	1.7%	1.7%
Decreased 5% - 25%	7.8%	7.8%
Little change	54.6%	52.9%
Increased 10% to 50%	32.7%	34.6%
Increased > 50%	3.2%	3.0%
Total	*100.0%*	*100.0%*

Source: Arundel, Bordoy & Kanerva, 2008

Results confirmed in an econometric model that controls for size, sector, country, total innovation expenditures, innovative capabilities.

Conclusions

Five conclusions

1. Survey data requires appropriate statistical models – be careful about causality and interaction effects!
2. Do not over interpret your data – assume that respondents answer your questions literally.
3. Often helpful to supplement survey research with in-depth interviews.
4. If you are interested in ‘heavily explored’ topics, find something new and of interest.
5. Still many ‘unexplored’ areas, even using existing survey data.